GEOLOGIC CHARACTERIZATION OF INDIAN LAKE

VOLUSIA COUNTY, FLORIDA

By

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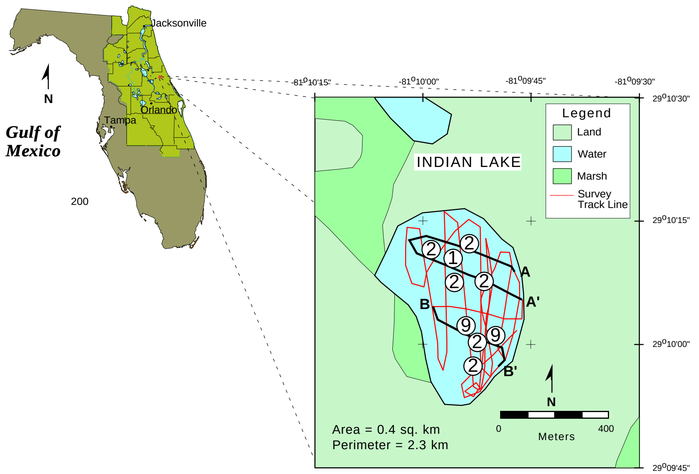
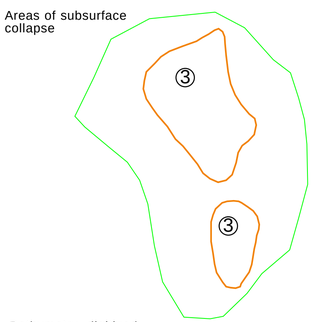
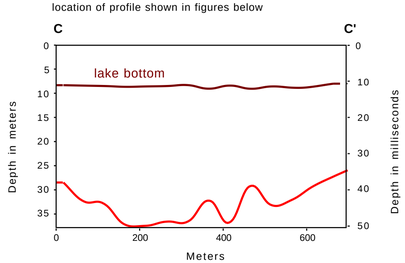
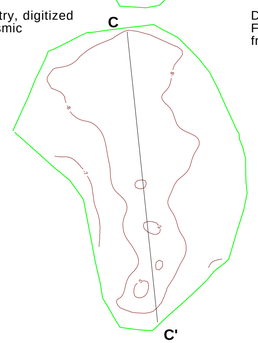
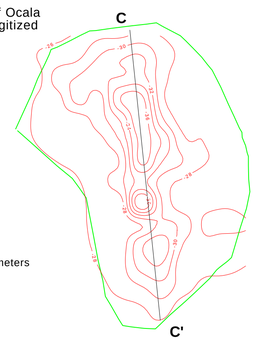
1997



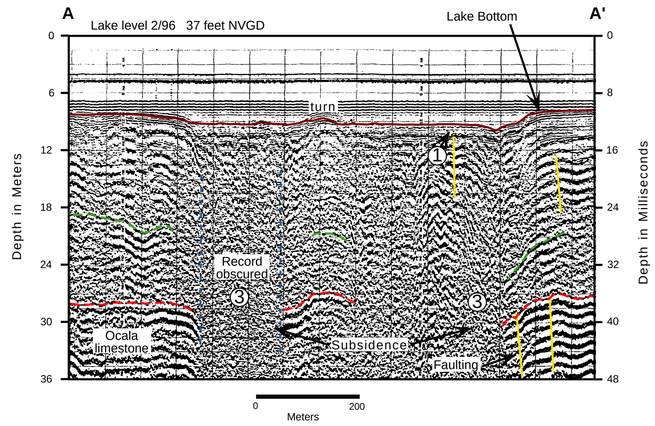








contours in meters



INTRODUCTION

The potential fliud exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridian aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and; (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntec Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntec Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Forty-four line-km of HRSP data was collected from Lake Disston. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

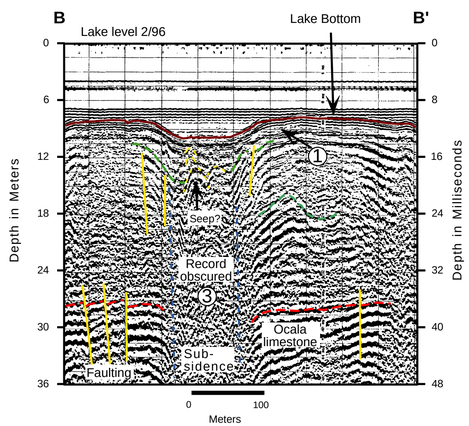
These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

Physiography

Indian lake is located in north central Volusia County, Florida. The lake is situated along Rima Ridge of the Volusia Ridge Sets, in the Eastern Flatwoods District. Lake level at the time of the seismic survey was 11.3 m (37 ft) NVGD. Indian lake has an oblong shape with a perimeter of 6 km and a surface area of 2.2 square km. Rima Ridge is bordered on either side by Tiger Bay and Bennet swamps. Bumcomb hill is situated to the north of the lake.

GEOLOGIC CHARACTERIZATION

Indian Lake is characterized by two areas of subsidence within the lake. These areas are shown in the map to the lower left. Seismic profiles A-A' and B-B' are oblique cross-sections across the two depressions. Seismic profile A-A' shows a bi-directional view of the larger of the two subsidence areas, as the survey trackline turns and crosses the depression twice. The profile shows a strong reflective horizon (red) at about 28 meters below lake level (9 meters above NVGD). This horizon is interpreted to be the top of the Ocala Formation, as correlated elsewhere in the study area with Gamma-Log profiles. It appears that a 150 meter wide area of the Ocala has collapsed, causing a concommitant subsidence in the overlying structure. Seismic profile B-B' shows the smaller subsidence to the south of the lake. Some structure such as collapse-related faulting and a possible signal characteristic of a freshwater plume is better retained in this record. Because of the lack of visible features within the collapsed areas, these profiles show characteristics similar to a Type 2 interpretation shown in the explanation to the right. In the uppermost part of the profiles, a relatively transparent signal characteristic of organic debris and sands (Type 1) appear to be infilling the depressions. Contour plots of the lake bottom and lower horizon, digitized from the seismic profiles, are shown to the lower left. The cross section C-C' above the contour plots was generated from the digitzed surfaces.



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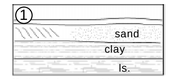
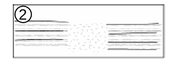
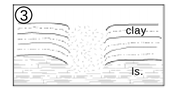
EXPLANATION



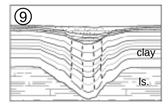
Undisturbed section, with or without upper non-reflective sand layer. Sand layer may show reflection where cross bedding from original deposition (fluvial or aeolian) exits. Clay layers are mostly intact.



Undisturbed section with areas obscured by noise created by muck or aquatic vegetation dispersing the acoustic signal.



Horizontal reflectors continuous on either side of a central non-reflective zone. Horizontal layers bend downward towards the central zone. These features are representative of filled collapse sinks. The size may range from tens of meters to kilometers across a lake basin.



Low- to mid-angle subsidence depressions. Parallel reflectors have undergone displacement and rotation, creating stress fractures and faulting within the depression. The subsidence may or may not be filled with overburden.